This chapter presents an optimization strategy of designing products for the life cycle. In Section 20.1, the fundamental product design decision making procedures based on clarification of the product environmental conditions are first explained. Practical methodologies corresponding to the product environment are described with applied examples in Sections 20.2, 3 and 4. In these procedures, relationships between evaluative characteristics are clarified. Information of features and behaviors of product environments is concurrently utilized for realizing the actual construction of the most satisfactory product design.

Concurrent engineering is an effective and powerful methodological philosophy for obtaining the most satisfying product design possible from an integrated and global viewpoint. The products to be manufactured are related with the product life phases of manufacturing products, selling products, using products, disposing products, recycling products and so on. In product design, the conditions relating to each issue of the product life cycle, that is, the environmental conditions of the products, should be completely comprehended and the information obtained from that knowledge concurrently utilized at the maximum level in the decision making process of product designs.

20.1 DESIGN FOR PRODUCT LIFE CYCLE

Figure 20.1 shows an optimum product design procedure including the following three general steps:

(1) Product life cycles are clarified and issues identified. Based on the clarification, characteristics to be evaluated are specified.
(2) The relationships between the evaluative characteristics are clarified.
Decision making problems are formulated and the optimum solution is obtained.

In usual product design and product optimization, step (3), the formulation of an optimization problem and solving the problem, receives the most attention. However, steps 1 and 2 are essential for obtaining the most satisfactory design solutions.

Figure 20.1 Flowchart of optimum design for product life cycle issues.

20.1.1 Product Life Phases

There are three distinct general stages in product life cycle as shown in Figure 20.2:

(i) The environment related to “manufacturing products” where requirements from different divisions such as design and manufacturing divisions are satisfied.

(ii) The environment related to “selling products” where market needs are to be sufficiently surveyed.

(iii) The environment related to “using products” where conditions for use of products are completely understood.